Negative Emotion Does Not Hinder Expression of Implicit Learning in a Contextual Cueing Task

Undergraduate Honors Research Thesis Proposal

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By

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Abstract

The efficiency of everyday visual search has been shown by previous studies to depend heavily on the context. Repeating contexts in a search task over time allows targets to be found more quickly within a familiar display versus a random display, an effect measured with a contextual cueing task. Research has shown that emotion can have a significant impact on this effect. This study aims to investigate further the effect of negative emotion on contextual cueing learning as well as the expression of learning. A contextual cueing task was administered to participants (N = 39) twice. Session one involved a baseline 1-hour contextual cueing task for all participants, with no emotional images. Two types of displays were used: nonpredictive (randomized) and predictive (repeating). Session two (1-7 days later) involved another contextual cueing task with interspersed presentation of International Affective Picture System photographic stimuli to induce either a neutral (N = 20) or negative (N = 19) mood. Three types of displays were used: nonpredictive, predictive, and old (predictive display that was previously learned in session one). All participants completed the Positive And Negative Affect Schedule, which confirmed that affective state differed significantly between the two groups. Analysis of variance revealed that in session one, RTs for predictive displays and nonpredictive displays differed significantly, demonstrating a contextual cueing effect. Session two showed that the benefit for old displays when compared to nonpredictive displays was the same for both groups, demonstrating that expression of previous learning was not influenced by negative emotion. Unexpectedly, there was no difference in either group between nonpredictive and predictive displays, indicating that interspersing photographic stimuli may impair new learning. Data from this study will be important in future studies, as it raises important questions on emotional interaction with the mechanism of learning versus the expression of learning.

Keywords: contextual cueing, implicit learning, emotion.

Introduction

Imagine driving by a gruesome, graphic car accident. There's a decent chance that instead of paying attention to the road, you will probably want to see the aftermath of the tragedy occurring on the median instead. You may want to stare at the totaled car, the people carrying a body into the ambulance, the blood that paints the ground scarlet. This is commonly known as "rubbernecking," or taking attention away from driving to look at the crash (Most, Chun, Widders & Zald, 2005). People are so distracted by the violent scene that they often suffer from a decline in their driving quality due to inattention (Chun & Jiang, 1998). This concept of rubbernecking in has been studied systematically in psychological literature, known as "emotion-induced blindness" (Most, Chun, Widders & Zald, 2005). Based on the theory of emotion-induced blindness, emotionally distressing images should distract you and make it harder to pay attention to important stimuli (Kennedy, Rawding, Most & Hoffman, 2014). However, other research indicates that the focus of attention is narrowed in cases of negative emotion induced by threatening stimuli (Flykt, 2006).

What are the consequences of failing to devote attention to important stimuli? The role of selective attention is to prioritize the processing of relevant stimuli; this means that things that are not attended will likely not be deeply processed (Leber, Egeth & Lamy, 2012). There are numerous evolutionary mechanisms that are contingent upon attention. For example, if an organism saw a snake in the grass, it would be beneficial for it to pay attention to the snake, as it may pose a threat to the organism. According to Flykt (2006), this process is analogous in human beings, and negative mood induction narrows one's attention. Flykt attributes this effect to preparedness for action, during which an organism allocates attentional focus to the stimuli one deems relevant to survival. Eventually, as an organism continues to experience a variety of contexts containing varying degrees of threat, it would seem logical that the organism would slowly learn to take a different path that minimizes threat. This is called implicit learning, or learning that occurs without conscious awareness, and it is incredibly important in aiding survival in nature. How might this apply to humans? Implicit learning is involved in many activities, for example, riding a bike. When a child learns to ride a bicycle, he or she does not sit in a classroom studying the physics of bicycle riding. Often, he or she will learn by trial and error as well as feedback from the environment (if the child falls left off of the bike many times, he or she will implicitly learn to lean slightly more to the right). Eventually, this implicit learning will be expressed as the child successfully rides the bicycle.

Implicit learning has been shown to influence the allocation of attention. This has been measured with a contextual cueing task when being observed in a laboratory setting (Chun & Jiang, 1998). Contextual cueing tasks are comprised of trials of visual search displays in which participants must locate a unique item among similar ones. Half of the search displays presented are novel randomized displays, and half are actually repeated displays, although participants are unaware of this (see Figure 1). As a result, successive response time for repeated displays decreases over time, suggesting that subjects are able to subconsciously predict where the unique object is on the repeated displays and move their attention directly to this location. A decrease in response times denotes the presence of the contextual cueing effect, indicating that implicit learning has occurred. In the original procedure, their analysis indicated that the contextual cueing effect manifested itself as a statistically significant interaction among display type (configuration could be novel or repeated) and epoch for the latter half of their session. With each successive epoch, the RT benefit widened for repeated displays over novel displays (Chun and Jiang, 1998). While numerous studies have been conducted to investigate the interaction between implicit learning and attention, we know little about how this interaction is influenced by a person’s emotions. This is important because many are affected by mental illnesses that result in a prolonged negative mood, which may impact everyday implicit learning processes. The present study aims to investigate this possibility so that those living with mood disorders can better adapt. In addition, millions of people suffer from traumatic brain injuries, but it is still unclear how their implicit learning is impacted as a result. Present research indicates that while implicit learning may not be impacted to the extent that explicit learning is impaired, the process of transferring implicitly acquired information to explicit behaviors is heavily impaired in victims of traumatic brain injury (Skidmore, 2015). Because TBI victims may have experienced physical and psychological hardship, emotional state could be a factor in recovering cognitive processes if it is found to be a factor in implicit learning.

While there have been many studies exploring the effect of implicit learning on attention, we know little about how this effect is influenced by a person’s emotions. This is important because mood disorders and trauma that result in a prolonged negative mood could alter the way a person implicitly learns. Recently, research has shown a decreased contextual cueing effect in subjects who were shown negative emotionally salient stimuli (Kunar, Watson, Cole and Cox, 2013). Participants were shown either neutral or negative images, designed to induce a neutral or negative mood. The study indicated a smaller effect of implicit learning in participants who were presented with negative emotionally salient stimuli, as compared to those presented with neutral stimuli. This suggests that being in a negative emotional state impaired the participants’ ability to implicitly learn. However, it does bring to question whether implicit learning simply did not take place, or if the participants’ abilities to express implicit learning was impaired. The reason why this is unclear is because they did not distinguish between acquisition and expression of implicit learning, by collecting baseline contextual cueing data for comparison with the performances of the group of subjects in a negative mood. Therefore, the results could have occurred because negative mood actually impaired implicit learning, or, negative mood had no effect on learning, but did impair the participants’ abilities to express the learning. Their data also could be attributed to the fact that there was no baseline contextual cueing performance assessment to account for inherent differences between the groups. Finally, it is possible that the way that Kunar, Watson, Cole & Cox presented the IAPS stimuli simply wasn’t enough to induce significantly different affective states, but there is no way to know this, as they did not evaluate their participants’ emotional states. The present study will utilize a self-report of each participant's mood to ensure that distinct emotional states were achieved.

The purpose of this study was to determine whether or not the induction of a negative mood influences contextual cueing ability as compared to a neutral mood. Specifically, this research aims to differentiate the expression of previous implicit learning from acquisition of new learning.

The basic design of my study consisted of a two-session experiment. Session one served as a baseline contextual cueing evaluation for all participants, during which there was no mood induction. Half of all search displays were nonpredictive and random, while half were predictive displays that repeated.

Participants were then divided into either negative (group 1) or neutral (group 2) condition groups for session two, which took place between a day and a week later. In session two, a negative or neutral mood was induced, by presenting the participants with IAPS stimuli throughout the session. In order to distinguish between implicit learning and expression, three types of search displays were present: nonpredictive (random), new predictive, and old predictive (predictive displays introduced in session one).

The present study had three independent variables. Predictability of visual display varied between nonpredictive displays (random), new predictive displays (repeated within the session), and old predictive displays (repeated from the previous session). Affective state was also manipulated; all subjects were eventually exposed to either negative emotional stimuli or neutral stimuli. Finally, time was an independent variable that was measured by epoch, which was exactly a sixth of a session. The dependent variable was response time, measured in seconds. In the present study, I will be comparing the contextual cueing performances of the two groups across two sessions. I had four possible hypotheses before running the experiment.

Hypothesis One

If subjects in the negative group have response times on the contextual cueing task that decrease at a faster rate than those of the control group ($p \leq 0.05$), one can conclude that negative emotion induction improves implicit learning.

Hypothesis Two

If subjects in the negative group have response times on the contextual cueing task that decrease at a slower rate than those of the control group ($p \leq 0.05$), while the response times for old trials from session one decrease faster than repeated trials from session two, one can conclude that negative emotion hinders implicit learning.

Hypothesis Three

If subjects in the negative group have response times on the contextual cueing task that decrease at a faster rate than those of the control group ($p \leq 0.05$), while the response times for old trials from session one decrease at the same rate as repeated trials from session two, one can conclude that negative emotion hinders expression of implicit learning, but not necessarily implicit learning itself.

Hypothesis Four

If subjects in the negative group have response times on the contextual cueing task that decrease at roughly the same rate than those of the control group ($p \geq 0.05$), one can conclude that negative emotion has no significant effect on implicit learning. If this result occurs, I will have to investigate the differences between old predictive and nonpredictive separately from my analysis of new predictive versus nonpredictive, in order to determine if negative emotion affected expression or acquisition of implicit learning.

Methods

Participants

Data from 39 participants, ages 18 to 40 (*M* = 18.98, *SD* = 1.40) with normal or corrected-to-normal vision, was used in the study (see Figure 2). Forty-three participants were originally run in this study, but data from four subjects was discarded. Students in the psychology Research Experience Program (REP) were recruited and awarded credit through the online system for participation separately for each session. All participants completed session one without being exposed to any stimuli. For session two, participants were divided into two conditions. Group 1 consisted of 20

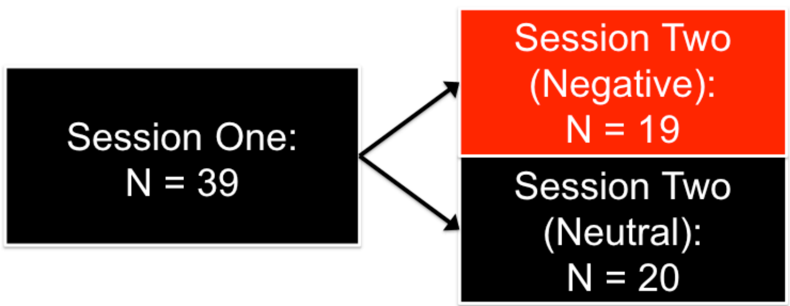

Figure 2: Experimental design, dividing of control and affect group.

participants who were exposed to neutral stimuli in session two. Group 2 consisted of 19 participants who were exposed to negative stimuli in session two.

Equipment, Materials and Stimuli

The study was carried out in a small behavioral testing room. The room was consistently lit and sound attenuated. The testing room had an Apple Mac Mini computer with an LCD monitor. MATLAB (Mathworks, Natick, MA), along with the PsychToolbox extensions (Brainard, 1997; Pelli, 1997) was used to control stimulus presentation and RT collection.

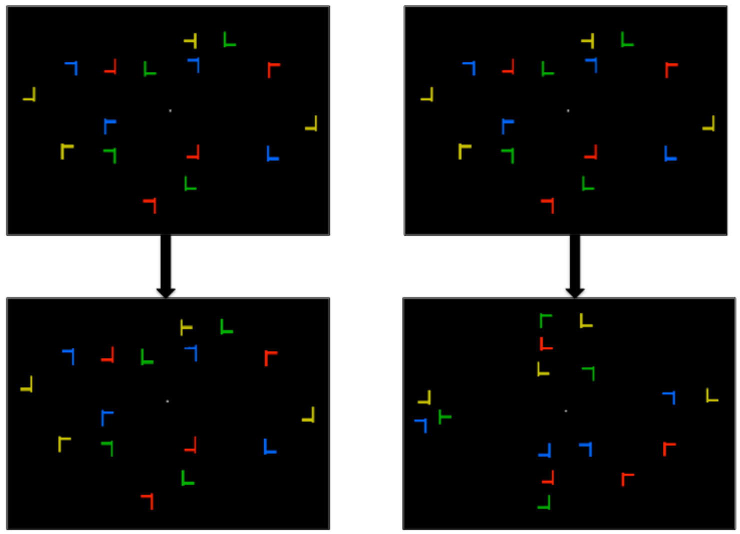

Figure 1: Predictive display (left) versus nonpredictive display (right).

The search display consisted of 16 items, including 15 distractors and one target. The distractors were randomized red, blue, green, or yellow “L” shapes oriented at either 0°, 90°, 180° or 270°. The target “T” shape was also randomized to either be red, blue, green or yellow, and could be rotated with the stem pointing left or right (90° or 270°) with equal probability of each. For predictive displays, the 15 distractors as well as the target were always in the same location (for a total of 8 distinct predictive displays that repeated throughout the experiment), therefore, the distractor configuration was predictive of the target location. For nonpredictive displays, the configuration was repeated, but the target location was random, so the distractors were not predictive.

All photographic emotional stimuli were collected from the IAPS database. Photographs were delineated as either “negative” or “neutral” according the published technical manual of affective ratings (Lang, Bradley and Cuthbert, 2008). The manual contains a set of ratings for each photograph that accounts for three dimensions, valence, arousal and dominance. On a self-reported basis, 1 represented a score of low pleasure/arousal/dominance, while 9 represented a score of high pleasure/arousal/dominance. For all intents and purposes, in the context of the present study a stimulus was considered “negative” if it had a low valence rating of between 2 and 4, excluding extreme images with scores of less than 2 to minimize risk of lasting psychological distress. Examples of negative IAPS images included photographs of surgical procedures, vomiting, defecation, violence and similar content. A stimulus was considered “neutral” if it had a rating between 4.5 and 6.5. Examples of neutral IAPS images included photographs of household appliances, faces with neutral expressions, foods, landscapes and similar content. A total of 204 neutral images and 173 negative images were utilized for this procedure.

Procedure

The consent process began as soon as participants arrived at the lab in which the experiment will take place. Participants were asked to read over the first consent form and to sign after having read it over. Prior to the second session of the experiment, example images were presented to the Group 2 participants, and the experimenter ensured that the participant was comfortable with continuing the experiment before beginning the task. Before the second session, a separate consent form was also given to all subjects. The contextual cueing task consisted of presenting visual stimuli on a computer screen (in this case a letter “T” among “L”s, see Figure 1). For the first session, there was no mood induction, in order to assess their default contextual cueing ability. All subjects completed a 16-session practice block to familiarize themselves with the task. For the session one experimental trials, participants completed 480 trials, which were completed over 30 blocks for a total of 16 trials each (see Figure 3).

Each trial began with the presentation of a fixation cross in the center of the screen for 1000 ms, followed by the search display. Participants responded with a “1” if the T stem pointed left, and with a “2” if the T stem pointed right (see Figure 1). All session one displays were either nonpredictive (randomized) or predictive (repeated). 240 nonpredictive displays were completed in session one, as well as 8 predictive displays that were each repeated 30 times to equal 240 trials for a total of 480 displays.

Session 2 was conducted after at least a day’s and at most a week’s delay (depending on availability of the subject). Participants were randomly assigned to one of two groups. Group 1 was shown images that evoked strong negative emotions, and group 2 was presented with neutral images. Prior to starting session two of the experiment, all subjects completed a 24-trial practice session. They then viewed a continuous stream of 20 IAPS images, designed to begin the process of mood induction. The experiment trials were then presented. New images were presented interspersed between trials for 1000 ms. These appeared pseudo-randomly, presented every 3-7 trials, in order to ensure that participants couldn't predict when an image would appear, and therefore could not look away from the image. For the session two experimental trials, participants completed 720 trials, which were completed over 30 blocks for a total of 24 trials each (see Figure 3). All session two displays were either nonpredictive (randomized), new predictive (repeated in session 2), or old predictive (repeated back in session 1). A total of 240 nonpredictive displays were completed in session one, as well as 8 predictive that were each repeated 30 times to equal 240 trials, plus the same 8 old predictive displays from session one that were each repeated 30 times for a total of 720 displays (see Figure 2). Participants in both the negative group and the neutral group took the PANAS paper-and-pencil survey to ensure mood induction was achieved (Watson, Clark & Tellegen, 1988). The PANAS consisted of ten positive emotions and ten negative emotions. Each subject rated how much they felt each on a scale of 1 being the lowest, and 5 being the highest. The scores for negative emotions were then subtracted from the scores for neutral emotions to produce a "net affect score" for each of the 39 participants.

Group 2 participants were also given the option to view a positive mood induction (after completing the PANAS) in order to counter the negative mood induction. This involved viewing positively salient video clips, and several participants in Group 2 selected this option. As a result, there were no subjects who were excessively emotionally distressed after completing the experiment. All were provided with the contact details for Counseling and Consultation Services at The Ohio State University.

Results

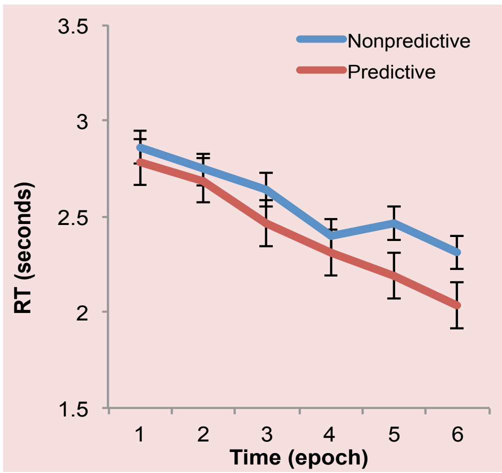

Figure 3: Group 1, session 1 with no images.

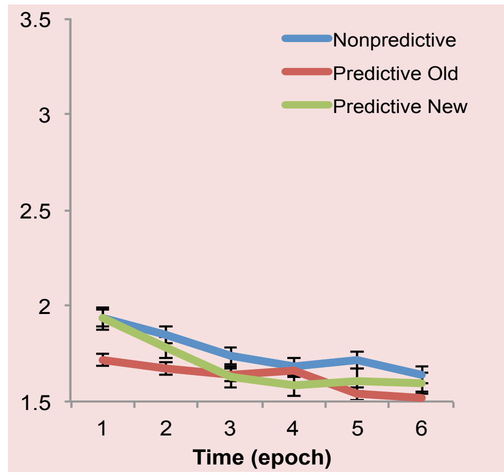

Figure 4: Group 1, session 2 with negative images.

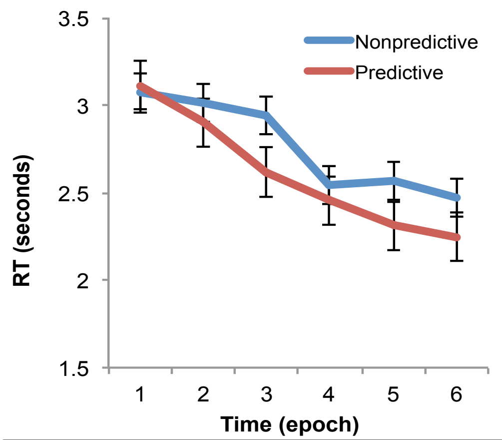

Figure 5: Group 2, session 1 with no images.

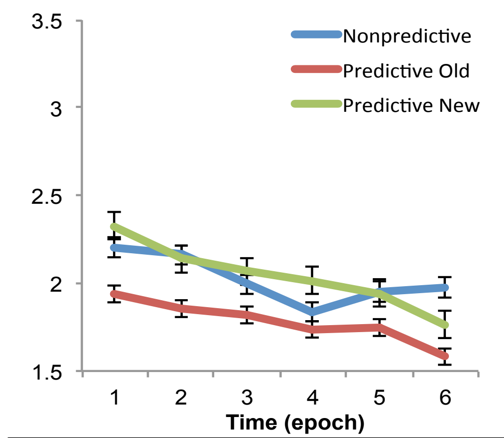

Figure 6: Group 2, session 2 with neutral images.

In session 1, group 1 (who would eventually see negative images) had an average of 96.5% accuracy. Group 2 (who would eventually see neutral images) had 96.0% accuracy. In session 2, group 1 (who saw negative images) had an average of 97.3% accuracy, and group 2 (who saw neutral images) had 97.2% accuracy. Incorrect responses, practice trials, response times (RTs) under 0.300

seconds, and RTs greater than three standard deviations from each participant's mean RT were not included in the analysis. For the analysis, time was measured by dividing the 30 blocks into 6 epochs of 5 blocks each. Data were analyzed using mixed ANOVAs, and where sphericity was violated, we used the Greenhouse-Geisser correction.

Session 1

For all session one (baseline) RT data, we ran a 2 (group: neutral versus negative) by 2 (predictability: nonpredictive versus predictive) by 6 (epoch) mixed analysis of variance. There was no main effect of group ($F(1,37) = 0.65$, $p = 0.424$). There was a main effect of predictability ($F(1,37) = 37.71$, $p < 0.001$), with predictive displays having lower RTs. There was also a main effect of epoch ($F(3.76,138.92) = 64.92$, $p < 0.001$), meaning as time went on, RTs decreased. The interaction of epoch and group was not significant ($F(5,185) = 0.18$, $p = .942$), which was expected since no stimuli were shown during session one. This implies that the contextual cueing effect did not differ between the groups. The interaction of predictability and epoch was significant ($F(5,185) = 3.63$, $p = 0.007$). This shows predictability & epoch interact to influence response time, indicating a contextual cueing effect was successfully achieved. Therefore, implicit learning did occur during session one and there was no significant difference between the groups' performances.

Session 2

For all session two RT data, we ran a 2 (group: neutral versus negative) by 3 (predictability: nonpredictive versus new predictive versus old predictive) by

6 (epoch) mixed analysis of variance. There was no main effect of group ($F(1,37) = 0.06$, $p = 0.805$). There was a main effect of predictability ($F(2,74) = 45.11$, $p < 0.001$). There was also a main effect of epoch ($F(2.72,100.72) = 25.25$, $p < 0.001$), meaning as time went on, RTs decreased. The interaction of epoch and group was not significant ($F(5,185) = 1.30$, $p = 0.265$), which indicates that there was no difference in performance between those in an induced negative mood versus a neutral mood. However, predictability and epoch interacted significantly ($F(10,370) = 2.10$, $p = 0.024$) to influence response times, but because there were three display types in session two (nonpredictive, new predictive, and old predictive), we then separately analyzed the data for old and new predictive against the nonpredictive response times.

It was not clear from the previous analysis whether of not the effect of predictability was due to old predictive or new predictive displays; two more ANOVAs were performed to allow differentiation between acquisition and expression of learning. A repeated-measures ANOVA was performed comparing nonpredictive displays to new predictive displays (those learned in session two). Surprisingly, there was no main effect of predictability, ($F(10,37) = 1.76$, $p = 0.193$), nor did predictability interact with epoch ($F(10,37) = 1.94$, $p = 0.101$). There was no main effect of group ($F(1,37) = 0.23$, $p = 0.637$). This suggests that no new implicit learning occurred in session two and a contextual cueing effect was not achieved. There were no interactions between either of these variables and group, indicating that emotional state did not have any bearing on these results.

However, upon performing an ANOVA that compared nonpredictive displays to old predictive displays (learned in session one), it was found that the main effect of predictability was significant ($F(2,74) = 45.11$, $p < 0.001$). There was no main effect of group ($F(1,37) = 0.06$, $p = 0.805$). There was also a main effect of epoch ($F(2.72,100.72) = 25.25$, $p < 0.001$), meaning as time went on, RTs decreased. The interaction between predictability and epoch was non-significant ($F(10,370) = 1.88$, $p = 0.114$), showing that there was already an effect of predictability, even by the first epoch. There were no interactions between any of the variables and group, indicating that emotional state did not have had any bearing on these results. This suggested that the expression of implicit learning that had already been acquired in the first session was not influenced by emotional state.

PANAS data

The data was analyzed by consolidating all PANAS net affect scores and executing an independent-samples t-test for a comparison of means. Group 1 (N = 19) had a net affect score of -0.36, and group 2 (N = 20) had a net affect score of 1.10. These means are different ($p < 0.001$), demonstrating that the IAPS stimuli were in fact effective in their ability to induce a negative mood. Therefore, it was concluded that because the difference between the groups' PANAS scores were statistically significant, two distinct emotional states were efficaciously induced.

As a follow-up analysis, all trials that directly proceeded an image were removed and the remainder reanalyzed determine if there was a difference between the data as a whole and the trials occuring immediately after an interspersed image. The pattern of results were identical and the results of the statistical tests were the same, so the method of stimulus presentation was not the likely reason for these results.

Discussion

To summarize this experiment's results, new implicit learning did not occur when exposed to either neutral or negative stimuli, but expression of previous implicit learning was retained in both groups. This best corresponded to my fourth hypothesis of null effect. Throughout the entire experiment, group (negative or neutral) was insignificant, and had no more than insignificant interactions with other variables. We discovered that emotional state did not affect expression of implicit learning. This was evidenced by the immediate differences between old predictive and nonpredictive displays during session two in both groups. The paper by Kunar et al. (2013) was unable to determine whether their results occurred as a result of acquisition or expression of implicit learning, but the present study's results indicate that expression of implicit learning is not likely the explanation.

One possible explanation for these results is the fact that the photographic stimuli (in both mood conditions) were interspersed throughout the task rather than being relegated to the beginning of the session. In the Kunar et al. paper (2013), the stimuli were shown before each session but not within each session as in the present study. Although they did achieve a statistically significant difference in the neutral versus negative groups, they did not evaluate participants' moods or their baseline contextual cueing performances. Therefore, their method of stimulus presentation raises doubts that the difference found was rooted in actual mood induction. Our method of stimulus presentation was chosen because we wanted to ensure that a mood was induced, in which we were successful. There was a possibility, though, that interspersing photographs into the task could have affected the RTs of the subsequent trials. However, in analyzing the data, we took out the trials that immediately followed a photographic stimulus, and the pattern of results was essentially unchanged. Therefore, the likelihood that the stimuli themselves were responsible for the results is unlikely.

A more probable explanation for the results is that the expression of implicit learning (old predictive displays) may have interfered with the acquisition of new learning (new predictive displays) in session 2. There is a psychological phenomenon called blocking, in which certain stimuli are ignored if they are believed to have no effect on a given outcome in favor of attending to items that seem to be predictive (Le Pelley, McLaren & Oakeshott, 2005). In the circumstances of my experiment, this could have ensued due to the immediate recognition of old predictive displays causing participants to devote less attention to the new predictive displays. In other words, a subject in session two might recognize an old predictive display and infer that old predictive displays are the only displays in which the entire contextual configuration helps predicts the location of a target. Consequently, throughout session two, the participants may have subconsciously decided not to attend to the context of new predictive displays from the first time they are shown, therefore they would not have been able to utilize the entire configuration to find the target faster when these displays were repeated.

This contention is further supported by a study by Beesley, Vadillo, Pearson and Shanks (2015), in which a pre-exposure effect is established in contextual cueing. They posit that exposing trials to participants before the task facilitates implicit learning. The mechanism behind this effect, the study suggests, is by association of each element of a configuration with the display as a whole. This enables the participant to find the target more quickly because it eliminates the need to attend to each individual distractor in a serial search. Instead, the target is located efficiently by auto-associative memory output of what was input during the pre-exposure phase. This effect may have dominated over any new learning that could have happened during session two and is the most plausible explanation for the results obtained in this experiment.

This study data differs from the findings of Kunar, Watson, Cole and Cox, whose data indicated that a significantly smaller contextual cueing effect was obtained when subjects viewed negative emotionally salient stimuli as compared to those viewing neutral stimuli (2013). In contrast, this present study did not find significant difference in contextual cueing effect. However, their study also showed that negative emotional state did not affect overall RTs, which is consistent with our findings.

Looking back at the experimental design in this present study, this discrepancy is almost certainly due to variation within the negative stimuli. Due to the necessity for large numbers of IAPS images, when selecting negative stimuli, images were characterized by valence only. The fact that no effect between neutral and negative stimuli occurred is likely because the motivational intensity of the images were not considered. Gable and Harmon-Jones (2010) conducted an experiment in which negative stimuli of high motivational intensity (such as fear and disgust) narrowed the focus of attention while negative stimuli of low motivational intensity (such as sadness) did not. This phenomenon leads us to believe that further discrimination between the negative images could have resulted in a different outcome, if negative stimuli were selected specifically for high motivational intensity (as measured by arousal ratings).

Implications

The implications of this study address psychological issues in society today. Mood disorders affect millions of Americans, the most common being major depressive disorder (MDD), bipolar disorder (BD), dysthymia, substance-induced mood disorder, and mood disorders related to medical condition (Johns-Hopkins University, 2016). Mood disorders can range in severity, but for some they can cause difficulties in day-to-day life. It is only natural to question how these mental illnesses affect implicit learning, a critical process in everyday life.

The data obtained in this experiment provides evidence to support the notion that implicit learning ability should not suffer as a result of negative emotional state. This may have implications for research on attentional control in mood disorders. It was unclear, prior to this study, whether or not mood disorders could be liable for learning deficits in addition to their symptoms of emotional distress. However, because this research utilizes subjects from a non-clinical population, this extrapolation of my data cannot definitively rule out the possibility that mood disorders inhibit contextual cueing.

Furthermore, differentiating between types of negative stimuli (high versus low motivational intensity) would allow researchers to better separately predict the effects of mood disorders that are generally characterized by low arousal (e.g. depression) versus other mental illnesses characterized by high arousal (e.g. anxiety, panic disorder, or personality disorders) that could have entirely different effects on implicit learning. Future research that distinguishes arousal and dominance between stimuli of negative emotional valence could affirm this experiment's findings, especially if samples came from clinically diagnosed populations.

References

Beesley, Vadillo, Pearson and Shanks (2015). Pre-exposure of repeated search configurations facilitates subsequent contextual cuing of visual search. *Journal of Experimental Psychology, Learning, Memory and Cognition,* 41, 348–362.

Bekiempis, V. (2014, February 28). Nearly 1 in 5 Americans Suffers From Mental Illness Each Year. Retrieved from http://www.newsweek.com/nearly-1-5-americans-suffer-mental-illness-each-year-230608.

Brainard, D. H. (1997). The Psychophysics Toolbox. Spatial Vision, 10, 433–436.

Chun, Marvin M., and Yuhong Jiang. "Contextual Cueing: Implicit Learning and Memory of Visual Context Guides Spatial Attention." *Cognitive Psychology* 36.1 (1998): 28-71. Web.

Eysenck, M. (1988). Anxiety and attention. *Anxiety Research,* 9-15. DOI: 10.1080/10615808808248216

Flykt, A. (2006). Preparedness for action: Responding to the snake in the grass. The American Journal of Psychology, 119, 29–43. DOI: 10.2307/20445317

Gable, P. A., and Harmon-Jones, E. (2010). The blues broaden, but the nasty narrows: Attentional consequences of negative affects low and high in motivational intensity. *Psychological Science*, 21, 211–215. DOI: 10.1177/0956797609359622

Kennedy, B. L., J. Rawding, S. B. Most, and J. E. Hoffman (2014). “Emotion-induced Blindness Reflects Competition at Early and Late Processing

Stages." *U.S. National Library of Medicine.* doi: 10.3758/s13415-014-0303-x.

Kunar, Watson, Cole and Cox (2013). "Negative emotional stimuli reduce contextual cueing but not response times in inefficient search." *The Quarterly Journal of Expermiental Psychology*, 67, 377-393. DOI: 10.1080/17470218.2013.815236

Lang, P.J., Bradley, M.M., and Cuthbert, B.N. (2008). International affective picture System (IAPS): Affective ratings of pictures and instruction manual. Technical Report A-8. University of Florida, Gainesville, FL.

Le Pelley, M. E., McLaren, I. P. L., and Oakeshott, S. M. (2005). Blocking and Unblocking in Human Causal Learning. *Journal of Experimental Psychology,* 31(1), 56-70. DOI: 10.1037/0097-7403.31.1.56

Leber, Andrew B., Howard E. Egeth, and Dominique Lamy (2012). "Selective Attention." *Handbook of Psychology: Experimental Psychology.*: 267-90.

Most, S. B., Chun, M. M., Widders, D. M., & Zald, D. H. (2005). Attentional rubbernecking: Cognitive control and personality in emotion-induced blindness. *Psychonomic Bulletin & Review*, *12*(4), 654-661.

Overview of Mood Disorders (2016). Retrieved March 6th, 2016, from http://www.hopkinsmedicine.org/healthlibrary/conditions/mental_health_disorders/overview_of_mood_disorders_85,P00759/

Pelli, D. G. (1997). The VideoToolbox software for visual psychophysics: Transforming numbers into movies. Spatial Vision, 10, 437–442.

Skidmore, E. R. (2015). Training to Optimize Learning After Traumatic Brain Injury. *Current Physical Medicine and Rehabilitation, 3*(2), 99-105. doi:10.1007/s40141-015-0081-6

Watson, D., Clark, L. A., and Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology,* 54(6), 1063-1070. DOI: 10.1037/0022-3514.54.6.1063

Weissman, A., Chu, B., Reddy, L., and Mohlman, J. (2012). Attention Mechanisms in Children with Anxiety Disorders and in Children with Attention Deficit Hyperactivity Disorder: Implications for Research and Practice. *Journal of Clinical Child & Adolescent Psychology,* 117-126. DOI: 10.1080/15374416.2012.651993